



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/928,430	08/14/2001	Kazuyuki Nitta	2001-1143A	8121

513 7590 11/12/2003

WENDEROTH, LIND & PONACK, L.L.P.
2033 K STREET N. W.
SUITE 800
WASHINGTON, DC 20006-1021

EXAMINER

LEE, SIN J

ART UNIT	PAPER NUMBER
----------	--------------

1752

DATE MAILED: 11/12/2003

1/0

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/928,430

Examiner

Sin J Lee

Applicant(s)

NITTA ET AL.

Art Unit

1752

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

P r i d for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 September 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 5-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 5-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Pri rity under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

1. Applicants submitted Rule 131 Declaration of Applicants, which establishes conception of present invention prior to the August 15, 2000 effective date of Ohsawa (6,440,634) coupled with diligence leading to the filing of Applicants' Japanese priority application 2000-264529 on August 31, 2000. Therefore, the previous rejections on claims 11 and 12 under 35 U.S.C. 103(a) as being unpatentable over Watanabe'900 in view of Ohsawa'634 and further in view of Blakeney'507 as addressed in Paragraphs 3 and 4 of Paper No. 4 are hereby withdrawn. Furthermore, Blakeney states (col.10, lines 3-15) that their post-development heat treatment step comprise the baking of the coating and substrate *below* the coating's thermal deformation temperature. Since present post-development heat treatment is being performed to effect diminution of the pattern size by thermal flow of the resist layer, it is the Examiner's position that Blakeney's post-development heat treatment step, which is done below the coating's thermal deformation temperature, would not be able to effect diminution of the pattern size by thermal flow of the resist layer as presently recited.

2. Due to new grounds of rejections (for claims 11 and 12), the following rejections are made *non-final*.

3. Claims 1 and 5-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oomori et al (5,976,760) in view of Watanabe et al (5,876,900).

As shown in Example 1 below, Oomori teaches a positive photoresist composition comprising 100 parts by weight (pbw) of a polymer mixture containing 25

Art Unit: 1752

pbw of a polyhydroxystyrene having phenolic hydrogens replaced with a tertiary alkoxycarbonyl group (present (A2)) and 75 pbw of polyhydroxystyrene having phenolic hydrogens replaced with an alkoxyalkyl group (present (A1)). The composition also comprises 3 pbw of an oxime sulfonate photoacid generator (present (B)), 0.06 pbw of triethylamine (present (E)), and 0.06 pbw of salicylic acid (present (D)).

EXAMPLE 1

A chemical-sensitization positive-working resist composition was prepared by dissolving, in 400 parts by weight of propyleneglycol monomethyl ether acetate, 25 parts by weight of a first polyhydroxystyrene resin having a weight-average molecular weight of 12000 with a molecular weight distribution $M_w:M_n$ of 4.6, which was substituted by tert-butyloxycarbonyl groups for 39% of the hydroxyl groups, 75 parts by weight of a second polyhydroxystyrene resin having a weight-average molecular weight of 12000 with a molecular weight distribution $M_w:M_n$ of 4.6, which was substituted by ethoxyethyl groups for 39% of the hydroxyl groups, 3 parts by weight of the oximesulfonate compound prepared in Preparation 1 described above, i.e. α -(1-naphthylsulfonyloxyimino)-4-methoxybenzyl cyanide, as the acid-generating agent, 0.06 part by weight of triethylamine and 0.06 part by weight of salicylic acid followed by filtration of the solution through a membrane filter of 0.2 μ m pore diameter.

Oomori does not teach present polyvinyl ether compound. As stated in the prior Office action, Watanabe teaches a positive photoresist composition comprising a polyhydroxystyrene polymer having phenolic hydrogens replaced with acid labile groups, a photoacid generator, an amine, and a polyvinyl ether. Watanabe teaches (col.3, lines 6-20) that using the polyvinyl ether in the composition not only brings an increased dissolution contrast owing to the function of an acid labile group contained in

Art Unit: 1752

the base resin and the function of a vinyl ether group capable of chemically converting into an acid labile group through heat cross-linking, but also results in improved heat resistance during etching because the crosslinked structure is maintained in unexposed areas. Thus, it would have been obvious to one of ordinary skill in the art to add a polyvinyl ether compound to Oomori's photoresist composition with a reasonable expectation of obtaining a chemically amplified positive resist composition having increased dissolution contrast between the exposed and unexposed areas and improved heat resistance during etching because Watanabe teaches that a composition having the combination of a polyhydroxystyrene having acid labile groups and a polyvinyl ether gives these results.

Therefore, Oomori in view of Watanabe would render obvious present inventions of claims 1 and 7-9.

With respect to present claim 10, Watanabe teaches (col.22, lines 46-55 and col.24, lines 27-31) the equivalence of triethylamine which is used in Oomori's Example 1 and triethanolamine as basic compounds which improves resolution and pattern profile. Therefore, because these two compounds were art-recognized equivalents at the time the invention was made, it would have been obvious to one of ordinary skill in the art to replace triethylamine in Oomori's Example 1 with triethanolamine. Therefore, Oomori in view of Watanabe would render obvious present invention of claim 10.

With respect to present claims 5 and 6, as explained in the prior Office action, Watanabe teaches (in his Example 10) "CL.1" (which chemical structure is shown in col.27-28) as one of the examples for his vinyl ether compounds. The chemical

Art Unit: 1752

structure of CL.1 meets the more general structure of formula (I) for Watanabe's vinyl ether compound which is shown in col.7, lines 28-40. In the formula (I), A would be $-\text{C}_6\text{H}_4-\text{C}(\text{CH}_3)(\text{CH}_3)-\text{C}_6\text{H}_4-$ (see col.8 lines 45-48), R^{14} would be an ethylene group, n would be 1, and m would be 2. Also, Watanabe teaches equivalence of CL.1 and $\text{H}_2\text{C}=\text{CH}-\text{O}-\text{CH}_2\text{CH}_2-\text{O}-\text{CH}=\text{CH}_2$ (since in the formula (I) A can be $-\text{CH}_2\text{CH}_2-$, n can be 0, and m can be 2). Since Watanabe teaches the equivalence of these two compounds as his vinyl ether compound of the formula (I), it would have been obvious to one of ordinary skill in the art to add Watanabe's $\text{H}_2\text{C}=\text{CH}-\text{O}-\text{CH}_2\text{CH}_2-\text{O}-\text{CH}=\text{CH}_2$ into Oomori's photoresist composition with a reasonable expectation of obtaining a chemically amplified positive resist composition having increased dissolution contrast between the exposed and unexposed areas and improved heat resistance during etching. Therefore, Oomori in view of Watanabe would render obvious present inventions of claims 5 and 6: since in $\text{H}_2\text{C}=\text{CH}-\text{O}-\text{CH}_2\text{CH}_2-\text{O}-\text{CH}=\text{CH}_2$ present X would be $-\text{CH}_2\text{CH}_2-$, which is a residue derived from a molecule of CH_3CH_3 (which is an aliphatic hydrocarbon compound) by eliminating 2 hydrogen atoms, Oomori in view of Watanabe would render obvious present invention of claim 6.

4. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oomori et al (5,976,760) in view of Watanabe et al (5,876,900) and Jeoung et al (6,358,672 B2).

As explained above in Paragraph 3, Oomori in view of Watanabe renders obvious present positive-working photoresist composition of claim 11. Oomori furthermore teaches (col.15, lines 7-22) the procedure for photolithographic patterning

Art Unit: 1752

by using his inventive resist composition: A semiconductor silicon wafer is coated uniformly with the resist composition followed by drying to form a dried resist layer which is pattern wise exposed to actinic rays such as *deep UV light* followed by a post-exposure baking treatment. Thereafter, the resist layer is subjected to a development treatment with an aqueous alkaline developer solution to dissolve away the resist layer pattern-wise.

Therefore, Oomori in view of Watanabe teaches present invention of claim 11 except for the post-development heat treatment step (e). Oomori's photoresist composition is used in manufacturing semiconductor devices (see col.2, lines 26-35 and working examples which use a semiconductor silicon wafer as the substrate). Jeoung teaches a method of providing a desired size of a semiconductor device pattern through the irradiation of UV light on a developed photoresist pattern and then *performing a flow process so that a desired pattern size can be effectively achieved* (see col.1, lines 21-29). Jeoung states (col.1, lines 64-67, col.2, lines 1-4) that DUV photoresist generally has a difficulty in forming a photoresist pattern having a size shorter than the wavelength of the exposure light source and that currently, the resolution of a contact hole pattern in the photolithography process is lower than that of a line and space pattern so that the pattern uniformity over all of the wafer surface is not good. Jeoung furthermore teaches (col.2, lines 10-21 and col.9, lines 47-53) that one of the methods for forming the contact hole having a smaller size than the wavelength of the exposure light source is a flow process method for a photoresist pattern in which a photoresist pattern is heated over the softening point of the photoresist so as to bring the softening

Art Unit: 1752

of the highly polymerized photoresist and reduce its viscosity and flow the photoresist pattern thereby making the pattern size for the contact holes smaller. As the result, Jeoung states that the size of the photoresist pattern is reduced. Jeoung's method include (a) coating a wafer with a photoresist (i-line or Deep UV photoresist) (b) aligning a photomask on the photoresist and carrying out an exposure (c) forming a photoresist pattern on the wafer by development (d) carrying out a crosslinking of the photoresist pattern by a hard bake step so that the distortion of the photoresist pattern during a flow process is prevented; and (e) carrying out a flow bake for the photoresist pattern after the crosslinking in order to effectively obtain a desired pattern size. Jeoung states (col.11, lines 36-46) that his method prevents the bulk effect which is a phenomenon of the distortion of the photoresist pattern due to the flow difference between the condensed pattern portion and the little pattern portion. Based on the teachings of Jeoung and based on the fact that Oomori also teaches a deep UV photoresist composition useful for manufacturing a semiconductor device, it is the Examiner's position that it would have been obvious to one of ordinary skill in the art to apply Jeoung's semiconductor device fabrication system to Oomori's invention by performing the hard bake step and the flow bake step after Oomori's development step in order to reduce the size of the photoresist pattern without the bulk effect (i.e., the distortion of the photoresist pattern) so that a desired semiconductor device pattern size can be obtained effectively as taught by Jeoung. Therefore, Oomori in view of Watanabe and Jeoung would render obvious present invention of claim 11.

With respect to present claim 12, it would have been obvious to one of ordinary skill in the art to optimize the condition of the flow bake in Oomori so that a desired photoresist pattern size can be obtained effectively without the distortion of the photoresist pattern, and when one does that, Oomori's patterned resist layer would inherently exhibit a diminishing change in a dimension by an amount not exceeding 15 nm per degree centigrade of the temperature change as presently recited. Besides, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Therefore, Oomori in view of Watanabe and Jeoung would render obvious present invention of claim 12.

Response to Arguments

5. Applicants argue that the improvement of thermal flow behavior of a patterned resist layer of present invention cannot be expected by a combination of the teachings in Oomori and Watanabe because of the difference in the types of the base resins in Watanabe and in the present invention. Applicants furthermore argue that since the thermal flow behavior of a patterned resist layer is a matter of rheological behavior of a crosslinked resin at an elevated temperature, which naturally is affected by the types of resin, one skilled in the art would not be motivated, without benefit of applicants' disclosure in present application, to mix the photoresist composition of Oomori with a polyvinyl ether compound taught by Watanabe because there references are each silent on the thermal flow process and the polyvinyl ether compound is used in Watanabe for

Art Unit: 1752

merely increasing the crosslinking density. Applicants' such arguments are found to be unpersuasive because the Examiner never stated that one would be motivated to use Watanabe's vinyl ether compound in Oomori's composition in order to improve the thermal flow behavior of a patterned resist layer. The Examiner clearly established the motivation for using Watanabe's vinyl ether compound in Oomori's composition, i.e., to obtain a chemically amplified positive resist composition having increased dissolution contrast between the exposed and unexposed areas and improved heat resistance during etching as taught by Watanabe. In combining references, one does not have to have the same motivation as that of present invention. What is necessary is a motivation to combine, and that motivation is not required to be the same as that of present invention. It is still the Examiner's position that it would have been obvious to one of ordinary skill in the art to add a polyvinyl ether compound to Oomori's photoresist composition with a reasonable expectation of obtaining a chemically amplified positive resist composition having increased dissolution contrast between the exposed and unexposed areas and improved heat resistance during etching because Watanabe teaches that a composition having the combination of a polyhydroxystyrene having acid labile groups and a polyvinyl ether gives these results.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sin J. Lee whose telephone number is (703) 305-0504. The examiner can normally be reached on Monday-Friday from 8:30 am EST to 5:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ms. Janet Baxter, can be reached on (703) 308-2303. The fax phone

Art Unit: 1752

number for the organization where this application or proceeding is assigned is (703) 872-9311 for after final responses or (703) 872-9310 for before final responses.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-0661.

S. Lee

S. Lee
11/6/03

A handwritten signature in black ink, appearing to read "Mark F. Huff", with a long horizontal flourish extending to the right.

**MARK F. HUFF
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700**